CURRENCY ARRANGEMENTS AND GOODS MARKET INTEGRATION: A PRICE BASED APPROACH

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Abstract

Recent studies of the effect of currency arrangements on goods market integration (starting with Rose, 2000) employ a methodology based on volumes of trade. However, the connection between market integration and trade flows can be loose. In this paper, we adopt a different methodology that uses a 3-dimensional panel of prices of 95 very disaggregated goods (e.g., light bulbs) in 83 cities around the world from 1990 to 2000. We find that the impact of an institutionalized stabilization of the exchange rate, i.e., a currency board or a currency union, generally provides a stimulus to goods market integration that goes far beyond reducing exchange rate volatility to zero. However, there are important exceptions. Among the institutional arrangements, long-term currency unions demonstrate greater integration than more recent currency boards. All of them can improve their integration further relative to a U.S. benchmark.

Key Words: hard pegs, currency board, dollarization, market integration.
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1. Introduction

The consequences of exchange rate volatility, and more generally, currency arrangements, are at the heart of open economy macroeconomics yet professional opinion on their impact on goods market integration is divided. Witness the debate (and accompanying fanfare) surrounding the launch of the single European currency. Prominent among the skeptics, Feldstein (1997) argued that the euro would impose large costs upon its member countries without providing substantial economic benefits. This conclusion is based partly on his reading of the empirical literature up to 1997 that generally reported a small effect of exchange rate stabilization on trade volumes.

In contrast, a recent influential paper by Rose (2000), argues that adopting a common currency provides a substantial expansion of the volume of trade; an effect that goes beyond the impact of reducing exchange rate volatility to zero. Indeed, Rose estimates that the presence of a common currency increases bilateral trade among members by as much as 300% over what would be expected between otherwise identical countries. Frankel and Rose (2002), Engel and Rose (2001), Glick and Rose (2002), and Rose and van Wincoop (2001) have provided further extensions and support to this claim. Building on results in Frankel and Romer (1999), Frankel and Rose (2002) have gone on to argue that having a common currency provides a substantial boost to the member countries' output growth. For example, they estimate that dollarization would raise an average country's income by 4 percent over twenty years. On the other hand, this line of research has also attracted criticism. Persson (2001) and Tenreyro (2002) have suggested that the trade promotion effect of a common currency is greatly exaggerated due to the possibility of endogeneity of existing common currency areas, and Klein (2002) has argued that the basic results in Rose (2000) are not robust when the sample is restricted to certain sub-samples.

Regardless of their ultimate conclusions, all existing studies share a common methodological approach: they gauge market integration using observed trade flows, and draw inferences from an estimated version of the gravity model. This approach however, has its limitations; key among them is that the mapping between the volume of trade and the degree of market integration is not tight. In general, the volume of trade depends not only on factors that gravity equations control for (size, distance, etc.), but also on the degree of substitutability of each country's output. Generally speaking, a given increase in trade barriers would generate a larger response in trade volumes if the degree of substitutability is higher. To put the same message a different way, a particular pair of countries may trade more than another pair, even in the presence of greater barriers. That is, the true degree of market integration can be lower, despite a higher volume of trade.[1]

Moreover, the degree of substitution and membership in a common currency can be correlated. For example, certain European countries and their former colonies are more likely to share a common currency in the Rose (2000) sample than a random group of countries. However, former colonies and their colonizers are also likely to produce goods that have a relatively low degree of substitution with one another. In this case, the estimated effect of currency arrangements on trade volume might be biased upward; thus giving a misleading picture of the true effect of currency arrangements.

In this paper, we adopt a different approach that is based on observed *deviations from the law of one price* (*DLOP*). This approach does not share the limitations of the volume-based approach. Consonant with theory, changes in market integration will be reflected in prices whether trade occurs or not, since it is the *potential* for arbitrage that dictates how far apart

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[1] This point was recently illustrated by Wei (1996).

prices can diverge. To measure integration between any two geographic markets, our new approach uses a theory-inspired metric based on the empirical distribution of the *DLOPs* for a large and identical set of tradable products (e.g., prices of frozen chicken, light bulbs, toilet paper and tonic water, all standardized by weight or volume). The metric is motivated by an insight from Heckscher (1916), which states that the existence of positive arbitrage costs implies an inequality constraint between prices in two locations. This insight has been formalized in the recent literature on non-linear deviations from the law of one price including Obstfeld and Taylor (1997), Taylor (2001), and O'Connell and Wei (2002).

Our approach is facilitated by a unique cross-country data set on the prices of 95 very disaggregated goods among 69 countries in the world from 1990 to 2000 (inclusive). These 69 countries span every inhabited continent. The data, from the *Economist Intelligence Unit*, is the most extensive set available in terms of the scope of country and goods coverage from a single source. Assimilation by a single source insures greater comparability of the goods across international locations.

Two additional benefits can be derived from using this data set. First, because the data set covers 1999 and 2000, we are able to offer an early assessment of the effect of the euro – which started as an accounting unit on January 1, 1999 – on goods market integration. Second, we will use prices of the same set of goods in 14 U.S. cities to construct a benchmark of market integration, against which the effect of other currency arrangements can be compared.

Other studies have examined law of one price deviations. A partial list includes: Richardson (1978), Rogers and Jenkins (1995), Engel and Rogers (1996), Parsley and Wei (1996, 2001), Crucini et al. (2001), Rogers (2001), and O'Connell and Wei (2002). In particular, Engel and Rogers (1996) pioneered the metric for measuring market integration used in this paper. However, none of the papers has applied the methodology to study the impact of currency arrangements on goods market integration. With this new approach, we will show that some important findings in Rose (2000) can be confirmed while some others need to be qualified. We will also undertake some exercises that have not been done in this literature.

As noted, we exploit both time series and cross-sectional variation available in the panel of local currency price data from the *Economist Intelligence Unit*. In particular, we study all (unique) bilateral price comparisons the data allow. These bilateral comparisons contain both intra- and inter-continental dimensions. Thus, in this study, we go beyond previous studies using two country, or at most intra-continental, price comparisons only. The payoff from having this extensive data set is an ability to study a wide variety of currency arrangements including currency unions (e.g. Euro and CFA) and currency boards (Hong Kong and Argentina) in a unified framework.

In this study, we make a conceptual distinction between *institutional* versus *instrumental* stabilization of the exchange rate. The former refers to reducing volatility through dollarization, adoption of a currency board, or via another common currency. The latter refers to reducing volatility through intervention in the foreign exchange market or via monetary policies, i.e., any arrangement other than institutional stabilization. Institutional stabilization implies a greater degree of commitment and a much lower probability of reversal in the future. By removing one more layer of uncertainty, it is conceivable that an institutionalized stabilization can provide a greater stimulus to goods market integration than merely reducing exchange rate volatility to zero via an instrumental stabilization. How big the extra stimulus is, must be determined by an empirical analysis.

Our main findings can be briefly summarized. First, reducing nominal exchange rate variability reduces the range of observed deviations from the law of one price. Second, an economically stronger effect (by an order of magnitude) comes from a more institutionalized arrangement – such as a currency union or a currency board. Third, there is an important heterogeneity among different types of institutionalized currency arrangements. For example, the goods market among the CFA countries is not very integrated according to our price-based metric – despite the presence of a currency union among these countries. This suggests that a caveat is appropriate when making 'average' statements of the effect of a common currency on goods market integration. Fourth, these basic results survive when we endogenize the formation of common currencies and currency boards, and when we estimate the results on sub-samples of the data. Fifth, among all common currency arrangements, goods markets are most integrated in the United States. Of course, the U.S. shares not only a common currency, but also a host of other market unifying conditions including a common legal and regulatory framework. Thus, relative to the U.S. benchmark, European goods market integration still has further to go.

The rest of the paper is organized as follows. Section 2 provides a description of the basic *EIU* data set in more detail, along with other data sources that we consult. As the heart of our analysis, Section 3 has three parts: results from a benchmark regression; economic interpretation of the basic results; and finally, a sequence of extensions and robustness tests. Section 4 draws our conclusions.

2. Data and Basic Patterns

Data

The primary data set we employ contains standardized price comparisons for over 160 goods and services for up to 122 cities compiled by the *Economist Intelligence Unit*. The data come from the *Worldwide Cost of Living Survey*, and are designed for use by human resource managers for compensation policies. The data set is described in more detail at http://eiu.enumerate.com/asp/wcol_HelpWhatIsWCOL.asp. For many goods in the data set there are two prices: one from a supermarket and one from a 'high-priced outlet'. Our focus in this study is on traded goods; and among traded goods we selected supermarket prices when there was a choice.

Additionally, not all goods and cities are available in each time period. Since we are interested in both cross-sectional and time series variation, we dropped goods and cities with 'large' numbers of missing observations. We generally wanted all goods in the sample to be available for most cities in most years, hence we dropped goods with over 30% missing observations. Finally, we kept only one city per country (with the exception of the United States, which we use as a separate benchmark). The end result is a panel of 95 goods and 83 cities. Appendix Tables 1 and 2 list the goods and cities included.

In addition to the price data, we use data on tariff rates, from Table 6.6 of the World Bank publication *World Development Indicators* available on the World Bank web site. For each country, the tariff data are available for two years – once in the early 1990s and once for the late 1990s. We use the first reported value in our bilateral tariff rate calculations for the years 1990-95. Similarly, we use the most recent value for the years 1996-2000. The precise variable definitions are discussed below. For this study we selected the columns "simple mean tariff" and "weighted mean tariff" (page 336-39). Additionally, we use monthly exchange rates and money supplies from the April 2001 IFS CD for all countries except Taiwan, where the data was taken from the CEIC data base provided by the Hong Kong Institute for Monetary Research.

Some Examples of Percentage Price Differences

Let $P_{i,k,t}$ be the U.S. dollar price of good *k* in city *i* at time *t*. For a given city pair *(i,j)* and a given good k at a time t, we define the common currency percentage price difference as:

$$Q_{ij,k,t} = \ln P_{i,k,t} - \ln P_{j,k,t}\,. \tag{1}$$

As noted above, we study all bilateral price comparisons the data allow. There are 3403 city pairs (=(83x82)/2) – each with 11 (annual) time periods. Thus, for each of the 95 prices, the vector of price deviations will contain 37,433 (3403x11) observations without missing values. Since for any given city-pair or time period $Q_{ij,k,t}$ may be positive or negative, we first focus on absolute percentage price deviations.

As an illustration of the basic features of the data, Table 1 presents the percentage price dispersion (in absolute value) for two selected products among several city pairs. We make no claim that these are representative. They serve only to give a flavor of the data set and to presage some of the features we want to highlight.

The city pair Asuncion and Taipei is the farthest apart in our sample. The price difference for light bulbs and onions is also the biggest among the examples in Table 1 (though this need not be true for all the other products). A key issue that we will examine more formally is whether a reduction in exchange rate volatility would lead to a reduction in the segmentation of the goods market. Paris and Vienna have now belonged to a single currency union (euro) since the beginning of 1999. Comparing the price difference between the two cities in the pre-euro period versus the entire period, one observes a modest decline for the gap in the prices for light bulbs and onions. [Again, this need not be true for every product and is not true.] Among the examples in Table 1, the smallest price difference occurs between the two cities in the United States, Chicago and Houston.

The evidence in Table 1 is suggestive. Exchange rate stabilization, particularly institutionalized stabilization, appears to stimulate goods market integration. Of course, Table 1 is anecdotal, since only two products are exhibited out of 95 goods in our sample. A more systematic approach is required, which is what we turn to next.

3. Statistical Analysis

Empirical Methodology

It is tempting to measure goods market integration between two locations by some average of price differences across goods. However, this would not be appropriate. At least since Heckscher (1916), it has been recognized that the existence of positive costs of arbitrage imposes two inequality constraints on the prices of an identical good, *k*, in two different locations, *i* and *j*. Intuitively, once the price differential, $Q_{ij,k,t} = \ln P_{i,k,t} - \ln P_{j,k,t}$, goes out of a band, arbitrage activity becomes profitable and is likely to take place to bring the price back to inside the band. Within the band however, any realization of the price differential, $Q_{ij,k,t}$, is possible.

Heckscher's insight has been formalized recently by Obstfeld and Taylor (1997), Taylor (2001), and O'Connell and Wei (2002), among others. Obstfeld and Taylor (1997) and Taylor (2001), model a variable cost of arbitrage. There are two thresholds that define a band of no arbitrage. If the realized price difference strays outside the threshold, arbitrage activity would bring it back to the edge of the band. O'Connell and Wei (2002) provide a continuous-time general equilibrium model that allows for both fixed and variable costs in arbitrage. The prediction of the model can be summarized schematically in Figure 1. There are four thresholds for price differentials: two defining an outer band, c1 and c4; and two others defining an inner band, c2 and c3. If the price difference strays outside the outer threshold,

Q< c1, or Q>c4, arbitrage activities would bring it back to the edge of the inner band c2 or c3, whichever is closer. Importantly, inside the outer band, (c1, c4), however, any realized price dispersion is consistent with no arbitrage.

Coming back to our data set, we use the distribution of the observed price differentials (i.e., for each of the 95 goods) to estimate the no-arbitrage band (for each city-pair and time period). This would correspond to the outer band in O'Connell and Wei (2002). For simplicity, we do not attempt to measure the inner band. Our measure of goods market integration, then, would be the width of the no-arbitrage zone, which may vary across location pairs and time periods. In particular, any reduction to barriers to arbitrage (i.e., movements toward market integration) should reduce the no-arbitrage range. In addition to considering transportation costs and tariffs, we also examine whether exchange rate volatility and currency arrangements act as additional barriers to arbitrage.

As a start, we gauge the degree of market integration, or the width of the no-arbitrage zone by the <u>standard deviation</u> of the empirical distribution of the percentage price dispersion, $Q_{ij,k,t}$, over the 95 products. We recognize the possibility that the magnitude of the deviation from the law-of-one-price may depend on the type of the product. Hence, prior to calculating standard deviation, we remove the good-specific mean of the deviation at time *t*. More precisely, let $Q^*_{k,t}$ denote the average price dispersion for product k in year t over all city pairs. Define

$$q_{ij,k,t} \equiv Q_{ij,k,t} - Q^*_{k,t}\,. \tag{2}$$

Our measure of the barriers to arbitrage – or feasible range of deviations from perfect market integration – for city-pair *ij* in year *t* is the standard deviation of $q_{ij,k,t}$ over all 95 products. Note that we do not use the difference between max$\{q_{ij,k,t}\}$ and min$\{q_{ij,k,t}\}$ as a measure of the feasible range of DLOP as we do not want our measure to be driven by a few outliers. For the purpose of the subsequent analysis, we only need to measure the barriers to arbitrage for a particular pair of locations relative to another pair. Our maintained assumption is that the standard deviation measure adopted here is proportional to the true range of no-arbitrage across time and across different pairs of locations.

To ensure that our analysis does not depend on a particular measure of barriers to arbitrage, we will also examine two alternative ways to gauge the degree of market integration. The first alternative is the inter-quartile range, or the difference between the 75th and 25th quartiles in the empirical distribution of $q_{ij,k,t}$ over the 95 products for a given city-pair and time period. This metric would further limit the influence of possible outliers. The second alternative is to use the standard deviation of absolute percentage price differences, $\left|q_{ij,k,t}\right|$.

Table 2 presents some summary data grouped by institutional arrangements. It is obvious that most of the bilateral city-pairs in the sample are not part of an institutional exchange rate arrangement – indeed only 4.5% are members. In columns 2 through 4, the average dispersion, distance and exchange rate variability are reported. Distance is calculated using the great circle formula using each city's latitude and longitude data obtained from the United Nation's web site http://www.un.org/Depts/unsd/demog/ctry.htm. Exchange rate variability is defined as the standard deviation of changes in the monthly bilateral exchange rate (between the city-pairs involved) during each year. In Table 2 we can detect a positive correlation between average variability of relative prices and distance. The correlation with exchange rate variability is less obvious since Hard Peg city-pairs – with the second largest relative price variability, are on average quite far apart.

For illustration, Figure 2 presents the time series of the price dispersion averaged over all city-pairs and all products on a year-by-year basis. The downward trend is apparent in this figure. Of course, we do not yet know what factors influence the price dispersion. This is investigated more systematically below.

Basic Regressions

We begin our formal investigation of factors influencing goods market integration by estimating a benchmark equation:

$$\begin{aligned} BDLOP\left(q_{ij,t}\right) = {} & \beta_1 \ln(dist_{ij}) + \beta_2 \ln(dist_{ij})^2 + \beta_3(xrvol_{ij}) \\ & + \beta_4 HPeg + \beta_5 CFA + \beta_6 US + \beta_7 Euro \\ & + \beta_8 Language + \beta_9 Hyperinflation + \beta_{10} Tariff_{ij} \\ & + city\ dummies + \ time\ dummies + \varepsilon_{ij,t} \end{aligned} \tag{3}$$

$BDLOP\left(q_{ij,t}\right)$ is the Band of Deviations from Law of One Price for city-pair *ij* in year *t*. For convenience we measure the left hand side variable in percentage terms. In equation 3, *HPeg*, *CFA*, *US*, *Euro* are dummy variables that take the value 1 if the observation for the dependent variable involves cities that are both part of the same institutional arrangement. The language dummy takes the value 1 if the city pair shares a common language (either official or primary business language), and zero otherwise. The data was taken from the *CIA World Factbook* (http://www.cia.gov/cia/publications/factbook/ indexgeo.html). We also add a dummy for high-inflation episodes/countries. The episodes were Argentina (1992), Peru (1991), Mexico (1993), Uruguay (1993), Brazil (1993-4), and Poland (1995). We include both the log of the distance between cities i and j, and the log distance squared in the regression to account for possible non-linearity in the relationship. $Tariff_{ij}$ is defined (initially) as the sum of the two average tariff rates in countries i and j, unless the two cities are both in the same free trade area or customs union (such as within the United States, or within the European Union).

In these cases the value for tariff is set equal to zero. Later, we consider two alternative definitions of $Tariff_{ij}$ for robustness.

Table 3 presents the benchmark regression results. According to column 1, dispersion of relative prices increases with distance, consistent with the interpretation that distance is a proxy for transportation cost, and the effect is concave, i.e., distance increases dispersion, but at a declining rate. Increased exchange rate variability is also associated with increased relative price variability. In particular reducing monthly exchange rate variability from the sample average to zero reduces price dispersion by 0.26 percent (=0.067*3.82). However, participating in a hard peg – such as a currency board or adopting another currency reduces price dispersion by 3.21 percent – an order of magnitude more than simply reducing exchange rate variability. This seems to indicate that a hard peg confers more than simply exchange rate stability. The point estimate on the CFA dummy is positive, however it is not statistically significant. The estimate for the 'Euro' dummy also implies a relatively large reduction in price dispersion. It is in fact greater than that on the "Hard Peg" dummy (the χ^2 statistic from a formal test is significant at the 10% level), which suggests that the Euro is already having a noticeable impact. According to the estimates in Table 3, sharing a common language (or a common colonial past) – and all that that implies – reduces price dispersion significantly.

The strongest effect (statistically and economically) on price dispersion comes from being in the U.S., an effect we attribute to the higher levels of political and economic integration within the United States. The additional reduction in price dispersion associated with intra-U.S. cities is about three times larger than simply participating in a hard peg.

We can also express the economic effects of an institutional stabilization in terms of equivalent tariff reduction. According to the point estimates in the first column of Table 3, the effect of the euro on European goods market integration – in excess of reducing exchange rate volatility to zero – is equivalent to reducing the tariff rate in each country by 5 percentage points [=4.30/(0.43*2)]. The average external tariff rate of the developed countries is about 4 percent. So these estimates suggest that the extra stimulus to goods market integration resulting from implementing a common currency (like the euro) is of the same order of magnitude as eliminating tariffs among the European countries under its common market program of the 1990s. In other words, the economic effect is not trivial.

As a comparison, for a random pair of countries, reducing exchange rate volatility from the world average (0.067) to zero is equivalent to a tariff rate reduction of only 0.3 percentage points [3.82*0.067/(0.43*2)]. Finally, the economic and political union of the United States has the biggest stimulus on goods market integration. Belonging to such a union provides a reduction in goods price dispersion (in excess of reducing exchange rate volatility to zero) that is similar to a reduction in tariffs by 12 percentage points [=10.14/(0.43*2)].

In sum, the evidence presented in Table 3 points to four conclusions. First, reducing nominal exchange rate variability reduces relative price variability. Secondly, an economically stronger effect (by an order of magnitude) comes from participating in a hard peg – such as a currency union or explicitly abandoning the domestic currency and adopting a foreign currency. Thirdly, there is important heterogeneity in terms of the effect of different currency arrangements. In particular, membership in the CFA currency bloc does not confer any extra degree of integration in the goods market. As far as promoting goods trade is concerned, the CFA is a currency union in name only. Finally, the largest effects on integration come through political and economic integration. We next turn to robustness and sensitivity analysis.

Extensions and Robustness Checks

In this section we begin by considering (a) some additional explanatory variables, and

(b) some re-definitions of explanatory variables. Next we examine (c) different measures of the left-hand-side variable, namely, price dispersion. Finally, we consider (d) alternative specifications, including adding city-pair-specific random effects.

We begin by adding a measure of labor costs. This data was obtained from the *Economist Intelligence Unit* as well. The first is the absolute value of the wage difference between the cities. According to Column 2 in Table 3, increasing the absolute percentage difference in wage rates between the two cities raises price dispersion. In order to investigate a possible non-linear relationship we entered the absolute wage difference squared as well. In the final column of the table we see that wage differences appear to be reflected in price dispersion, though the effect is not linear.

Next we turn to two different alternative definitions of the tariff variable in the regression. In Table 3 the tariff variable is the sum of the two cities trade-weighted average tariff rates. In column 1 of Table 4, we substitute instead the sum of the simple average tariff rates. This change has virtually no effect on the magnitudes or statistical significance of the other variables in the equation, and the coefficient on the new tariff definition is only slightly smaller than that on the weighted-average tariff. The coefficient on the CFA dummy remains statistically insignificant. In Columns 2 through 4, tariff is redefined as the maximum of the two tariff rates between the two cities. The same qualitative conclusion applies.

Next, in column 3 we add the standard deviation of the wage difference – defined as the standard deviation of the absolute wage difference over the entire period. According to the parameter estimate, higher variability is associated with greater price dispersion. In the final column, we eliminate extreme observations of the dependent variable and re-estimate. Note that doing this lowers the fit of the equation and the statistical significance of the high-inflation dummy disappears. Apparently, the outliers closely approximate the hign-inflation periods.

The size of the "Euro" effect becomes slightly larger than that for the 'Hard peg', and the impact of exchange rate variability is smaller than before. However, none of the basic conclusions from Table 3 are changed.

In Table 5 we investigate the robustness of our results to an alternative definition of the left-hand-side variable. Specifically, we measure the dispersion in prices by the inter-quartile range of the percentage price difference between any two cities over the 95 goods, or the difference between the 75th percentile and the 25th percentile of the distribution of percentage price differences. We proceed as before, sequentially adding variables as we move through the columns in the table. Again, all the previous conclusions hold.

In Table 6, a third way to measure price dispersion is adopted – by using the standard deviation of the absolute differences in prices in percentage term. In Table 1 we presented some summary statistics on the average size of price differences across various groupings of city-pairs. Since positive and negative differences would tend to cancel each other out, the simple average would misrepresent the true extent of price differences.[2] Thus for comparability with Table 1, we re-estimate the equations with the standard deviation of absolute percentage price differences as the dependent variable. Once again, our conclusions remain substantively unaffected by this re-definition of the dependent variable. The main exception is that the CFA dummy now enters with a negative coefficient, and the effect of tariffs appears somewhat smaller than before. As before, the effects of joining the Euro appear larger than for other Hard-pegs, and represent an additional reduction of price dispersion beyond reductions in nominal exchange rate variability alone. Finally, the effect of going still further, i.e., to complete political and economic union, remains the largest institutional effect limiting price dispersion.

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[2] In principle, given that our focus is on the dispersion in prices, the tendency for positive and negative values to cancel should not be a concern (since dispersion is measured *around* the mean).

Because exchange rate variability is potentially endogenous, we also implement an instrumental variable estimation. The monetary theory of exchange rate determination indicates that the relative money supply (of the two countries in question) is an important determinant of their exchange rate. On the other hand, it seems unlikely that a country would change its money supply just to influence the dispersion of its tradable goods prices with another country. Therefore, on an ex ante basis, changes in the relative money supply could be a good instrument for changes in the exchange rate. Thus, we instrument the nominal exchange rate variability with the contemporaneous and lagged variability in relative money supplies. Variability of both exchange rates and money supplies is computed as the standard deviation of monthly changes in logs of each variable during the year.

Table 7 presents these results. Virtually the only change in this table from the previous results is that the coefficients on exchange rate variability have risen. According to Equation 4, (from the regression omitting extreme observations on the dependent variable), reducing exchange rate variability from the sample average to zero reduces price dispersion by 0.61 percent – twice as large as that reported in Table 3. Even with this larger effect of reducing exchange rate variability, all other conclusions – including the relative ranking of effects – remain as previously stated. In another iteration of instrumental variable estimation, we included a lagged value of exchange rate variability in the instrument set. Though we do not report these results here to save space, our conclusions are essentially the same as before.

To consider possible non-linear effects of exchange rate volatility on price dispersion, we include the square of exchange rate variability as an additional regressor. These results are reported in Table 8. The evidence suggests that the effect of exchange rate volatility on price dispersion is positive but concave: higher exchange rate volatility is associated with greater price dispersion, but the incremental effect gets smaller as volatility increases. Based on the estimates in this table, the effect of reducing exchange rate volatility from the sample average to zero is larger than before, but still much smaller than a hard peg.

So far, we use city fixed effects and year fixed effects to capture factors that may affect the dispersion in prices between cities that are not otherwise in the list of regressors. In Table 9, we add city-pair specific random effects to the regressions, in addition to the city and year fixed effects. These results are broadly similar to the previous tables. The primary exception is in the estimate for the Euro. It is generally much smaller than that for the Hard Peg dummy, and the Euro dummy looses its statistical significance in all equations. However, the coefficient on Hard Peg is statistically significant in each of the three specifications. The U.S. dummy remains highly statistically significant and economically dominates the other institutional arrangement effects.

In Table 10, we consider some alternative institutional classifications and controls for trade blocs. Among the Hard Peg arrangements that are studied in the sample, two of the country pairs – the Panama-US pair and the Belgium-Luxembourg pair – stand out by their long history. In the first column of Table 11 we replace our Hard Peg dummy with a separate dummy for long-term pegs (Panama-US, and Belgium-Luxembourg), and more recent currency boards (Hong Kong-US, and Argentina-US). Both these new dummies are statistically significant. The point estimate on long-term currency unions is roughly twice that for (more recent) Currency Boards. As we include more regressors (in columns 2-3), the estimate of reduction in price dispersion attributable to long-term pegs declines a bit (from -7.1 in column 1 to -5.7 percent in column 3), but the distinction between Long-term pegs and Currency Boards remains; the effect of long-term pegs on price dispersion is always above that for more recent currency boards.

We have been focusing on the differential effects of institutional versus instrumental stabilization of exchange rate volatility on the goods market integration. As an analogy, we can also examine whether formation of a trade bloc could have a different effect on goods market integration than a mere reduction in tariff rates. The idea is that a trade bloc implies a greater degree of commitment to maintaining low tariff (and non-tariff) barriers to trade on imports from member countries, i.e., reductions in tariffs are less likely to be reversed. To investigate this possibility, in column 2 of Table 10 we add controls for all the prominent trade blocs in Europe and in the Americas. These are: the European Union (EU), the European Free Trade Association (EFTA), the Central European Free Trade Area (CEFTA), the North American Free Trade Agreement (NAFTA), and Mercado Comun del Sur (MERCOSUR).

The coefficients on all of the trade blocs are negative, consistent with the interpretation that an institutionalized reduction in trade barriers (through the formation of a trade bloc) would promote greater integration in the goods market than merely reducing trade barriers through unilateral trade liberalization. The coefficients on four of the five trade blocs (i.e., except CEFTA) are statistically significant. Other conclusions are similar as before. Specifically, a reduction in exchange rate volatility promotes goods market integration in the form of a reduction in the range of price dispersion. A currency board arrangement promotes goods market integration to an extent much greater than merely reducing the exchange rate volatility to zero. Long-term currency unions such as the Panama's adoption of the U.S. dollar or the Belgium-Luxembourg currency union offer an even greater stimulus to goods market integration than a currency board. The degree of market integration associated with a long-term, political and economic union as the United States is the highest of all – i.e., the dispersion of prices for identical goods is the smallest. Time could change this. In the final column, we again eliminate outliers and a statistically significant effect of the Euro reappears, though it is much smaller than before. Also, statistical significance disappears for the Mercosur trade bloc dummy.

So far, we have not included city-pair fixed effects in the regressions (though city and year fixed effects have been included). This is because many variables of central interest to us, such as most of the currency arrangements, have virtually no time variation in our sample. The inclusion of the country-pair fixed effects would impede our ability to estimate these parameters of interest. However, if we restrict our interest to estimating the effect of exchange rate volatility, we could potentially include them. There are altogether 3403 city pairs (=83X82/2) in the sample. In Table 11, we include these city-pair fixed effects together with the year dummies. The coefficient on the exchange rate variable is still positive and statistically significant at the one-percent level. On the other hand, the size of the point estimates (between 1.3 and 3.4) is somewhat smaller than in the previous tables.

A surprise in Column 3 is that a greater absolute wage difference is associated with lower price dispersion. However, the estimates for nominal exchange rate variability, high inflation episodes, and tariffs are unaffected by these additional wage variables. In the final column, we remove the outliers (the top and bottom 1% of the observations in terms of the range of price dispersion) on the dependent variable. In this specification, the sign on the wage variables reverts to that reported in earlier tables. Overall, Table 11 confirms one of our main findings – namely, reducing nominal exchange rate variability lowers price dispersion. This effect is not driven by any omitted, city-pair-specific factor.

In the previous regressions, we have used observations on all pairs of cities that our data set allows – which means 3403 city pairs in total. Even though all the regressions include city dummies to absorb possible correlation in the residual due to the presence of a particular city, it is useful to gauge whether the basic results hold for a subset of city pairs. Hence, we construct a globally dispersed, but reduced, sample selecting one benchmark city per continent, and we omit 'overlapping' city pairs. That is, in this sub-sample, if city pairs 1&2 and 2&3 are included, then 1&3 are not included. Specifically, we select (a) all city pairs vis-à-vis Chicago (U.S.) – except for U.S.-euro and U.S.-CFA city pairs, plus (b) all euro city-pairs that involve Paris (France), plus (c) all CFA city-pairs that involve Abidjan (Cote d'Ivoire), plus (d) all city pairs vis-à-vis Tokyo (Japan) – except for Japan-U.S., Japan-euro, Japan-CFA, plus (e) all city pairs vis-à-vis Sao Paulo (Brazil) – except for Brazil-U.S., Brazil-euro, Brazil-CFA, and Brazil-Japan.

With this reduced sample, we re-estimate several key specifications and report the results in Table 12. As can be seen, the qualitative conclusions from the previous tables remain the same here. In particular, more volatile exchange rates, higher tariffs and longer distance are associated with a wider band of price dispersion between countries, while the euro, currency boards, and long-term common currencies are associated with large reductions in the width of the band of price dispersion. The effects of these institutionalized currency arrangements on goods market integration are an order of magnitude bigger than merely reducing exchange rate volatility to zero.

Endogenous Currency Unions

So far, we have taken currency unions and hard pegs as exogenously given. Persson (2001) and Terenyro (2002) argue that this could be problematic for the question that this paper examines. In this sub-section, we endogenize them and examine the consequences for the estimated effect of currency arrangements for goods market integration. Specifically, we estimate a system of two equations. The main equation links the band of deviations from the law of one price (*DLOP*s) for a given pair of countries to its currency arrangement and other determinants of the barriers to trade broadly defined.

$$BDLOP_{ij} = \theta CU_{ij} + X_{ij}\Gamma + e_{ij} \tag{4}$$

CU_{ij} is an indicator variable that takes the value of one if the *ij*-pair share a common currency or a currency board linking the currencies together.[3] X_{ij} is a vector of determinants of the no-arbitrage band *other* than the institutional arrangement.

Currency unions (and hard pegs) are endogenously determined, depending on the realization of a latent variable, CU^*.

$$\begin{aligned} CU_{ij} &= 1 \qquad \text{if } CU_{ij}^* > 0 \\ &= 0 \qquad \text{otherwise} \qquad (5) \\ CU_{ij}^* &= Y_{ij}\delta + u_{ij}. \end{aligned}$$

Where Y_{ij} is a vector of variables that influence the decision of a country (or pairs of countries) to adopt a common currency or currency board. e and u are iid normal with mean equal to zero, variances equal to σ_e^2 and σ_u^2, respectively, and with a correlation coefficient equal to ρ. This system can be estimated via the method of maximum likelihood.

A few remarks are in order before we proceed to the estimation results. First, we focus on the data from one year (2000), as the currency unions and hard pegs do not exhibit much variation over time within our sample. Second, the choice of variables that go into the Y_{ij} vector is guided by the optimal currency areas a la' Mundell (1961), McKinnon (1963), Kenen (1969) and more recent papers on the subject such as Alesina and Barro (2000). A leading candidate in this respect is some measure of the degree of synchronization of the two countries' business cycles, or SBC_{ij}, for short. We compute SBC_{ij} in two steps. In Step 1, we collect annual data on GDP for all the countries in the sample from 1980 to 1999. We apply either an

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[3] Note that we have treated common currencies and currency boards symmetrically, as we do not have a good way to endogenize the two separately.

HP-filter or a Band-Pass filter a la' Baxter and King (1999) to log GDP so that we can concentrate on the portion of the GDP movement that corresponds to what we think should be business cycle frequencies. Define $fgdp_j$ as the filtered version of log GDP(j) for country j. In Step 2, we compute the correlation between the filtered log GDP series of the two countries in question. Hence our "synchronization of business cycles" measure is:

$$SBC_{ij} = corr\left(fgdp_i, fgdp_j\right).$$

The result, using an HP(10) to filter log GDP in the treatment equation, is reported in Table 13. Column 1 reports the results of an OLS estimation using the 2000 data, which serves as a comparison for subsequent columns. Each of the columns 2-5 represents a variation of the basic specification of the two-equation system. The upper panel reports the results of the main equation, which links deviations from the law of one price to a dummy for currency union and other regressors. The lower panel reports the results of the treatment equation,which links currency unions to factors such as the synchronization of business cycles and the volume of the bilateral trade between the countries. In Column 2, the treatment equation includes only the synchronization of business cycles (*SBC*) and volume of trade variables. As can be seen, the likelihood of adopting a currency union increases as the two economies have more correlated business cycles or as they have a higher volume of goods trade. In the main equation on goods market integration (upper panel), the coefficient on the "currency union" dummy is -10.6 and statistically different from zero. This means that a currency union arrangement continues to be associated with a deeper integration in the goods market even when one allows the currency union decision to be endogenous. In fact, the quantitative effect is even bigger than the corresponding OLS estimate in Column 1.

In Column 3, we modify the treatment equation by replacing the volume of goods trade with a set of gravity determinants of bilateral trade. Specifically, we include: the product of the two countries' GDP; the product of the two countries' per capita GDP; log distance; a dummy ("border") for two countries sharing a common border; a dummy for common language; a common colonizer dummy; and a discrete variable for being landlocked. The variable Landlocked takes a value of '2' if both countries are landlocked, '1' if one of them is, and '0' otherwise. Most of these additional variables have sensible signs. More importantly, in the main regression (upper panel), the coefficient on the currency union dummy is negative and statistically significant. In fact, the point estimate is virtually the same as it was in Column 2, where a different specification of the treatment equation was used.

Because the product of the GDP's in the treatment equation is insignificant we drop this variable and re-estimate the system. The result is reported in reported in Column 4 of Table 13. The qualitative result stays the same. In particular, a currency union is found to promote integration in the goods market in a statistically significant way. In the earlier part of this section, we showed that the CFA zone appears to be different from other currency union arrangements by not being associated with deeper goods market integration. In Column 5 (the last column) of Table 13, we exclude CFA from the definition of the currency union dummy and enter it as a separate regressor. In this specification, the coefficient on the (modified) currency union is virtually the same as before and the coefficient on the CFA dummy is statistically insignificantly different from zero.

So far, the synchronization of business cycles, or *SBC*, is computed using the correlation of two countries' HP(10) filtered log GDP series. In Table 14, we apply an HP(100) filter to the log GDP series prior to computing the *SBC* measure. The HP(100) filter produces a smoother long-run trend component in the GDP series. Therefore, in principle, the resulting business cycle components could be different from those used in Table 13. In fact however, with the newly defined *SBC* variable, the estimation results in Table 14 are very similar to those in Table 13. In particular, currency unions are found to be associated with a reduction in the range of price dispersion by approximately ten percentage points, i.e., an economically significant increase in market integration.

In Table 15, we adopt yet another measure of *SBC* -- this time a Band-Pass filter (2, 8), as advocated by Baxter and King (1999). According to Baxter and King (1999), the Band-Pass filter may produce a filtered GDP series that corresponds more closely to the business cycles that macroeconomists have in mind.[4] As it turns out, as can be seen from Table 15, the SBC variable in the treatment equation, thus measured, is not statistically significant in any of the specifications. On the other hand, the coefficient on the currency union dummy in the main equation, which is central to the research question in this paper, continues to have a negative sign and is statistically significant. This is true for all specifications in Table 15. In fact, the point estimates are in the same ballpark as those in Tables 13 and 14.

To summarize, the attempt to endogenize currency boards and common currencies in this sub-section has not overturned the basic conclusion of the paper. Namely, institutional currency arrangements are associated with a statistically and economically significant deepening of goods market integration.

4. Conclusions

This paper empirically examines the effect of exchange rate arrangements on the integration of goods markets. The methodological innovation is to use the distribution of price deviations of identical goods rather than the volume of trade as the measure of market integration. We compare observed prices of 95 products for 3403 city-pairs for the eleven-year

[4] However, see Murray (2002) for a contrarian view

period 1990-2000.

There are a number of noteworthy findings. First, we find that goods market integration is inversely related to exchange rate variability and tariff barriers. Second, the impact of adopting a hard peg (currency board or currency union) is much larger than merely reducing exchange rate volatility to zero. Third, there is important heterogeneity among the currency arrangements that should not be ignored. In particular, the CFA countries do not have an integrated goods market despite sharing a common currency. On the other hand, long-term currency unions have a greater impact than more recent currency boards. Fourth, relative to the U.S. benchmark, all existing currency boards or common currencies such as the euro still have further to go to improve the integration of their goods market. Finally, we have subjected our basic results to numerous sensitivity tests and found them fundamentally robust to different definitions of the dependent and independent variables, different specifications, the exclusion of extreme values, and to different estimation methodologies – including making the decision to adopt a currency union endogenous.

A useful direction for future research is to combine the price-based approach here with the trade flow-based approach.

Table 1: Percentage Price Deviations in Absolute Value
(averaged over all years)

Asuncion-Taipei	
Light Bulbs	65.4
Onions	115.0
Paris-Vienna (1990-1998, pre-euro)	
Light Bulbs	13.4
Onions	45.3
Paris-Vienna	
Light Bulbs	11.4
Onions	40.1
Chicago-Houston	
Light Bulbs	8.9
Onions	42.7

Table 2: Dispersion and its Determinants:
Averages across city pairs and time

	Observations	$V(q(ij,t))$[4]	Distance	$V(s(ij,t))$[5]	Tarriff[6]
All City Pairs	36531	6.38	8215	0.67	22.3
Hard Peg City Pairs[1]	454	5.76	8602	0.01	9.8
US Only City Pairs	*975*	*3.78*	*2681*	*0.00*	*0.0*
CFA City Pairs[2]	110	6.29	3139	0.27	41.9
Euro City Pairs[3]	110	4.19	1273	0.00	0.0
Euro City Pairs (pre-Euro)	495	4.37	1273	0.13	0.0

[1]Hard Peg city-pairs are defined as city-pairs involving price comparisons between two cities maintaining a peg to the same currency. The Hard Peg classification includes three groups of bilateral pairs: (a) pairs that involve Buenos Aires (post 1992), Hong Kong, and Panama City, (b) bilateral pairs between those cities in (a) and U.S. cities, and (c) Brussels and Luxembourg.

[2]CFA city-pairs are defined as city-pairs involving price comparisons between two of the following cities: Abidjan, Dakar, Douala, Libreville, and Paris.

[3]Euro city-pairs are defined as city-pairs involving price comparisons between two of the following cities (post 1998): Amsterdam, Berlin, Brussels, Dublin, Helsinki, Lisbon, Luxembourg, Madrid, Paris, Rome, and Vienna.

[4]This column reports the average across relevant city-pair groupings (and time) of the dispersion of (de-meaned) percentage price differences.

[5]This column reports the average across relevant city-pair groupings (and time) of the variability of (defined as changes in log monthly) bilateral nominal exchange rates.

[6]Tariff is defined as the sum of the two individual tariff rates in countries i and j, unless the two cities are both in the United States, or they are both in the European Union. In these cases the value for tariff is set equal to zero.

Table 3: Benchmark Regression Results

	Equation 1	**Equation 2**	**Equation 3**
Log Distance	13.63	14.01	13.17
	(1.30)	(1.32)	(1.31)
Log Distance Squared	-0.67	-0.70	-0.65
	(0.08)	(0.08)	(0.08)
Nominal Exchange Rate Variability	3.82	3.03	4.59
	(0.50)	(0.52)	(0.50)
Hard Peg	-3.21	-2.13	-1.62
	(0.45)	(0.45)	(0.45)
CFA	0.34	0.79	0.63
	(1.33)	(1.33)	(1.31)
U.S.	-10.14	-9.53	-9.20
	(0.31)	(0.33)	(0.33)
Euro	-4.30	-3.76	-3.04
	(0.48)	(0.48)	(0.47)
Sum of Weighted Avg. Tariff	0.43	0.38	0.40
	(0.01)	(0.01)	(0.01)
Common Language	-1.98	-1.48	-1.10
	(0.19)	(0.19)	(0.19)
Absolute Wage Difference		0.48	3.03
		(0.07)	(0.20)
Absolute Wage Difference Squared			-0.23
			(0.02)
Year dummies?	yes	yes	yes
City dummies?	yes	yes	yes
Hyperinflation dummy?	yes	yes	yes
Adjusted R^2	.73	.78	.78
Number of Observations	27199	21675	21675

Robust standard errors are in parenthesis. All equations include city and time fixed effects.

Table 4: Alternative Tariff Definitions, and Omitting Extreme Values

	Equation 1	Equation 2	Equation 3	Equation 4
Log Distance	13.98	14.21	14.28	11.67
	(1.31)	(1.30)	(1.30)	(0.98)
Log Distance Squared	-0.71	-0.72	-0.73	-0.56
	(0.08)	(0.08)	(0.08)	(0.06)
Nominal Exchange	4.45	4.37	4.43	2.52
Rate Variability	(0.50)	(0.50)	(0.50)	(0.29)
Hard Peg	-1.80	-2.18	-2.19	-1.97
	(0.45)	(0.45)	(0.43)	(0.42)
CFA	0.98	1.90	2.28	2.01
	(1.15)	(1.26)	(1.26)	(1.22)
U.S.	-9.09	-9.83	-9.58	-7.93
	(0.34)	(0.32)	(0.33)	(0.27)
Euro	-3.23	-3.57	-3.27	-3.75
	(0.47)	(0.47)	(0.47)	(0.44)
Common Language	-1.23	-1.19	-1.43	-0.86
	(0.19)	(0.19)	(0.20)	(0.13)
Absolute Wage	3.03	2.89	2.82	3.29
Difference	(0.20)	(0.20)	(0.20)	(0.12)
Absolute Wage	-0.23	-0.22	-0.24	-0.25
Difference Squared	(0.02)	(0.02)	(0.02)	(0.01)
Standard Deviation of			1.13	0.64
Wage Difference			(0.15)	(0.06)
Sum of Equal Weighted Tariff	0.33			
	(0.01)			
Maximum of the Two Tariffs		0.38	0.38	0.37
		(0.01)	(0.01)	(0.01)
Year dummies?	yes	yes	yes	yes
City dummies?	yes	yes	yes	yes
High-inflation dummy?	yes	yes	yes	yes
Adjusted R^2	.78	.78	.78	.61
Number of Observations	21675	21654	21654	21189

Robust standard errors are in parenthesis. All equations include city and time fixed effects. The final column - designated Equation 4 - reports results from estimation with extreme observations on the dependent variable (above the 99th percentile and below the 1st percentile) dropped.

Table 5: Measuring Price Dispersion by the Inter-quartile Range of q

	Equation 1	**Equation 2**	**Equation 3**	**Equation 4**
Log Distance	18.56	16.04	15.80	12.73
	(2.16)	(2.17)	(2.16)	(1.55)
Log Distance Squared	-0.84	-0.71	-0.69	-0.51
	(0.14)	(0.14)	(0.14)	(0.10)
Nominal Exchange	4.34	3.85	3.81	4.91
Rate Variability	(0.80)	(0.74)	(0.743	(0.54)
Hard Peg	-5.45	-2.97	-2.89	-2.52
	(0.86)	(0.86)	(0.89)	(0.76)
CFA	3.47	4.26	3.68	3.13
	(1.91)	(1.91)	(1.91)	(1.83)
U.S.	-17.43	-16.44	-16.65	-14.28
	(0.53)	(0.55)	(0.56)	(0.41)
Euro	-7.22	-5.73	-6.04	-4.87
	(0.78)	(0.77)	(0.77)	(0.72)
Common Language	-1.51	-1.41	-1.10	0.04
	(0.33)	(0.34)	(0.34)	(0.22)
Sum of the Two Tariffs	0.43	0.38	0.40	0.46
	(0.01)	(0.02)	(0.01)	(0.01)
Absolute Wage		4.75	4.86	4.96
Difference		(0.31)	(0.30)	(0.20)
Absolute Wage		-0.33	-0.30	-0.36
Difference Squared		(0.03)	(0.03)	(0.02)
Standard Deviation of			-1.49	0.22
Wage Difference			(0.30)	(0.11)
Year dummies?	yes	yes	yes	yes
City dummies?	yes	yes	yes	yes
High-inflation dummy?	yes	yes	yes	yes
Adjusted R^2	.31	.39	.40	.52
Number of Observations	27344	21740	21740	21319

Robust standard errors are in parenthesis. All equations include city and time fixed effects. The final column - designated Equation 4 - reports results from estimation with extreme observations on the dependent variable (above the 99^{th} percentile and below the 1^{st} percentile) dropped.

Table 6: Measuring Price Dispersion by Standard Deviation of |q|

	Equation 1	Equation 2	Equation 3	Equation 4
Log Distance	11.55	10.91	9.65	7.48
	(1.34)	(1.25)	(1.22)	(0.91)
Log Distance Squared	-0.62	-0.57	-0.50	-0.36
	(0.08)	(0.08)	(0.08)	(0.06)
Nominal Exchange	6.44	3.58	2.80	1.21
Rate Variability	(0.62)	(0.53)	(0.49)	(0.29)
Hard Peg	-4.61	-2.62	-1.85	-1.86
	(0.47)	(0.38)	(0.36)	(0.35)
CFA	-2.38	-1.51	-1.65	-1.89
	(1.14)	(1.00)	(0.95)	(0.93)
U.S.	-6.40	-5.48	-4.92	-3.72
	(0.30)	(0.30)	(0.30)	(0.24)
Euro	-3.72	-4.47	-3.30	-3.48
	(0.50)	(0.44)	(0.42)	(0.41)
Common Language	-3.68	-2.70	-2.16	-1.71
	(0.20)	(0.19)	(0.19)	(0.13)
Weighted Avg. Tariff	0.35	0.27	0.29	0.29
	(0.01)	(0.01)	(0.01)	(0.01)
Absolute Wage		2.76	6.71	7.01
Difference		(0.19)	(0.20)	(0.12)
Absolute Wage		-0.37	-0.36	-0.37
Difference Squared		(0.02)	(0.02)	(0.01)
Standard Deviation of			0.27	0.09
Wage Difference			(0.15)	(0.05)
Year dummies?	yes	yes	yes	yes
City dummies?	yes	yes	yes	yes
High-inflation dummy?	yes	yes	yes	yes
Adjusted R^2	.67	.77	.78	.61
Number of Observations	27199	21675	21675	21218

Robust standard errors are in parenthesis. All equations include city and time fixed effects. The final column - designated Equation 4 - reports results from estimation with extreme observations on the dependent variable (above the 99th percentile and below the 1st percentile) dropped.

Table 7: Instrumental Variable Estimation

	Equation 1	Equation 2	Equation 3	Equation 4
Log Distance	14.76	14.38	14.54	11.45
	(1.40)	(1.40)	(1.40)	(1.01)
Log Distance Squared	-0.75	-0.73	-0.74	-0.54
	(0.09)	(0.09)	(0.09)	(0.06)
Nominal Exchange Rate Variability	8.53	10.77	9.53	8.74
	(2.00)	(1.82)	(1.80)	(1.58)
Hard Peg	-3.10	-1.79	-1.80	-1.54
	(0.47)	(0.46)	(0.44)	(0.43)
CFA	0.29	0.58	0.91	0.60
	(1.47)	(1.43)	(1.41)	(1.38)
U.S.	-9.98	-9.10	-9.01	-7.03
	(0.33)	(0.35)	(0.35)	(0.28)
Euro	-5.06	-4.19	-4.01	-4.09
	(0.49)	(0.48)	(0.48)	(0.43)
Common Language	-2.06	-1.27	-1.46	-0.81
	(0.20)	(0.20)	(0.21)	(0.13)
Sum of the Two Tariffs	0.44	0.40	0.39	0.39
	(0.01)	(0.01)	(0.01)	(0.01)
Absolute Wage Difference		2.98	2.95	3.45
		(0.26)	(0.26)	(0.14)
Absolute Wage Difference Squared		-0.21	-0.22	-0.24
		(0.02)	(0.02)	(0.01)
Standard Deviation of Wage Difference			0.83	0.38
			(0.16)	(0.06)
Year dummies?	yes	yes	yes	yes
City dummies?	yes	yes	yes	yes
High-inflation dummy?	yes	yes	yes	yes
Adjusted R^2	.73	.79	.79	.60
Number of Observations	24444	19415	19415	18952

Robust standard errors are in parenthesis. All equations include city and time fixed effects. The final column - designated Equation 4 - reports results from estimation with extreme observations on the dependent variable (above the 99th percentile and below the 1st percentile) dropped.

Table 8: Non-linear Effects of Exchange Rate Variability

	Equation 1	Equation 2	Equation 3	Equation 4
Log Distance	13.22	12.73	13.05	10.46
	(1.30)	(1.30)	(1.30)	(0.97)
Log Distance Squared	-0.66	-0.63	-0.65	-0.48
	(0.08)	(0.08)	(0.08)	(0.06)
Nominal Exchange Rate Variability	19.92	17.38	17.93	8.64
	(1.53)	(1.81)	(1.76)	(0.98)
Nominal Exchange Rate Variability Squared	-9.50	-7.49	-7.78	-3.46
	(0.88)	(0.99)	(0.97)	(0.51)
Hard Peg	-2.53	-1.12	-1.15	-1.18
	(0.46)	(0.45)	(0.44)	(0.42)
CFA	0.52	0.80	1.07	0.73
	(1.34)	(1.31)	(1.30)	(1.27)
U.S.	-9.81	-8.98	-8.81	-7.26
	(0.31)	(0.33)	(0.33)	(0.27)
Euro	-3.36	-2.30	-2.06	-2.94
	(0.49)	(0.48)	(0.49)	(0.45)
Common Language	-1.88	-1.12	-1.20	-0.68
	(0.19)	(0.18)	(0.19)	(0.13)
Sum of the Two Tariffs	0.43	0.40	0.39	0.38
	(0.01)	(0.01)	(0.01)	(0.01)
Absolute Wage Difference		2.95	2.77	3.36
		(0.19)	(0.20)	(0.12)
Absolute Wage Difference Squared		-0.22	-0.23	-0.25
		(0.02)	(0.02)	(0.01)
Standard Deviation of Wage Difference			0.81	0.33
			(0.15)	(0.06)
Year dummies?	yes	yes	yes	yes
City dummies?	yes	yes	yes	yes
High-inflation dummy?	yes	yes	yes	yes
Adjusted R^2	.73	.78	.78	.61
Number of Observations	27199	21675	21675	21201

Robust standard errors are in parenthesis. All equations include city and time fixed effects. The final column - designated Equation 4 - reports results from estimation with extreme observations on the dependent variable (above the 99^{th} percentile and below the 1^{st} percentile) dropped.

Table 9: Adding City-Pair Random Effects

	Equation 1	Equation 2	Equation 3
Log Distance	15.76	17.24	17.13
	(3.00)	(3.09)	(3.04)
Log Distance Squared	-0.79	-0.89	-0.89
	(0.18)	(0.19)	(0.19)
Nominal Exchange Rate Variability	3.30 (0.39)	3.56 (0.40)	3.58 (0.40)
Hard Peg	-3.82	-3.25	-3.26
	(1.47)	(1.41)	(1.40)
CFA	1.73	1.47	2.05
	(3.53)	(3.53)	(3.48)
U.S.	-12.59	-11.90	-11.4
	(1.05)	(1.06)	(1.04)
Euro	-0.13	-0.41	-0.35
	(1.19)	(1.07)	(1.07)
Common Language	-1.80	-1.59	-1.94
	(0.40)	(0.41)	(0.41)
Sum of the Two Tariffs	0.24	0.24	0.24
	(0.01)	(0.01)	(0.01)
Absolute Wage Difference		-0.17 (0.15)	-0.18 (0.15)
Absolute Wage Difference Squared		-0.001 (0.01)	-0.01 (0.01)
Standard Deviation of Wage Difference			1.31 (0.17)
Year dummies?	yes	yes	yes
City dummies?	yes	yes	yes
City-pair random effects?	yes	yes	yes
High-inflation dummy?	yes	yes	yes
Adjusted R^2	.81	.86	.86
Number of Observations	27199	21675	21675

Robust standard errors are in parenthesis. All equations include city and time fixed effects.

Table 10: Long-term Currency Unions and Trade Blocs

	Equation 1	Equation 2	Equation 3
Log Distance	10.29	10.16	8.40
	(1.29)	(1.28)	(1.00)
Log Distance Squared	-0.51	-0.50	-0.37
	(0.08)	(0.08)	(0.06)
Nominal Exchange	3.80	3.71	2.34
Rate Variability	(0.50)	(0.50)	(0.28)
CFA	-0.40	-0.39	-0.28
	(1.31)	(1.31)	(1.28)
U.S.	-11.48	-11.59	-9.50
	(0.35)	(0.35)	(0.28)
Euro	-4.25	-0.38	-1.63
	(0.48)	(0.48)	(0.48)
Common Language	-2.00	-2.10	-1.19
	(0.19)	(0.19)	(0.13)
Sum of the Two Tariffs	0.41	0.41	0.40
	(0.01)	(0.01)	(.01)
Long-Term Currency Union	-6.13	-6.19	-5.70
	(0.98)	(0.97)	(0.65)
Currency Board	-3.02	-3.05	-3.18
	(0.47)	(0.47)	(0.43)
European Union		-5.85	-4.48
		(0.38)	(0.29)
EFTA		-6.73	-5.85
		(1.45)	(1.34)
CEFTA		-3.77	-7.02
		(5.36)	(3.26)
NAFTA		-4.40	-3.51
		(0.51)	(0.47)
Mercosur		-2.09	-1.14
		(1.26)	(1.10)
Time and City Dummies?	Yes	Yes	Yes
High-inflation Dummies?	Yes	Yes	Yes
Adjusted R^2	.73	.73	.54
Number of Observations	27199	26664	26664

Robust standard errors are in parenthesis. All equations include city and time fixed effects. The final column - designated Equation 3 - reports results from estimation with extreme observations on the dependent variable (above the 99^{th} percentile and below the 1^{st} percentile) dropped.

Table 11: City-pair Fixed Effects

	Equation 1	Equation 2	Equation 3	Equation 4
Nominal Exchange Rate Variability	2.51 (0.33)	3.29 (0.40)	3.37 (0.41)	1.28 (0.20)
Sum of the Two Tariffs		0.10 (0.01)	0.13 (0.01)	0.10 (0.01)
Absolute Wage Difference			-1.73 (0.17)	1.56 (0.09)
Absolute Wage Difference Squared			0.11 (0.01)	-0.09 (0.01)
Time fixed effects?	yes	yes	yes	yes
City-pair fixed effects?	yes	yes	yes	yes
High-inflation dummy?	yes	yes	yes	yes
Removing extreme values?	no	no	no	yes
Adjusted R^2	.80	.79	.84	.84
Number of Observations	36292	27199	27165	21210

Robust standard errors are in parenthesis. All equations include city-pair and time fixed effects. The final column - designated Equation 4 - reports results from estimation with extreme observations on the dependent variable (above the 99th percentile and below the 1st percentile) dropped.

Table 12: Sub-Sample with Non-Overlapping City Pairs

	Equation 1	Equation 2	Equation 3
Log Distance	-8.09	-8.24	-8.94
	(4.25)	(4.46)	(4.43)
Log Distance Squared	0.67	0.70	0.74
	(0.26)	(0.28)	(0.28)
Nominal Exchange Rate Variability	2.06	4.04	4.18
	(1.63)	(1.85)	(1.83)
CFA	9.73	8.66	4.97
	(2.81)	(3.12)	(3.24)
U.S.	-11.31	-8.80	-9.67
	(1.07)	(1.10)	(1.13)
Euro	-1.60	-1.81	-2.53
	(1.14)	(1.11)	(1.28)
Long-Term Currency Union	-5.78	-5.13	-5.40
	(1.57)	(1.22)	(1.22)
Currency Board	-5.00	-2.99	-4.01
	(1.33)	(1.37)	(1.39)
Common Language	-6.92	-4.99	-2.60
	(0.76)	(0.86)	(1.08)
Sum of the Two Tariffs	0.32	0.36	0.42
	(0.03)	(0.04)	(0.04)
Absolute Wage Difference		3.25	2.87
		(0.76)	(0.75)
Absolute Wage Difference Squared		-0.23	-0.19
		(0.05)	(0.05)
Standard Deviation of Wage Difference			-1.37
			(0.26)
City Dummies?	Yes	Yes	Yes
Year Dummies?	Yes	Yes	Yes
High-inflation Dummy?	Yes	Yes	Yes
Adjusted R^2	.82	.86	.86
Number of Observations	1568	1271	1271

Robust standard errors are in parenthesis. This table uses a reduced set of country pairs. Specifically, the sample includes (a) all city pairs vis-à-vis Chicago (U.S.) – except for U.S.-euro and U.S.-CFA city pairs, (b) all euro city-pairs that involve Paris (France), (c) all CFA city-pairs that involve Abidjan (Cote d'Ivoire), (d) all city pairs vis-à-vis Tokyo (Japan) – except for Japan-U.S., Japan-euro, Japan-CFA, and (e) all city pairs vis-à-vis Sao Paulo (Brazil) – except for Brazil-U.S., Brazil-euro, Brazil-CFA, and Brazil-Japan.

Table 13: Endogenous Currency Unions

(System Estimation by Maximum Likelihood)

	Dependent variable: Band of Deviations from Law of One Price				
	OLS	Main Equation on Market Integration			
Currency Union	-3.49 (1.14)	-10.63 (1.42)	-10.55 (1.06)	-10.59 (1.05)	-10.35 (1.01)
Log Distance	17.81(3.21)	15.59 (3.05)	11.51 (3.24)	11.48 (3.23)	11.88 (3.04)
[Log Distance]^2	-0.90 (0.19)	-0.78 (0.18)	-0.54 (0.19)	-0.54 (0.19)	-0.56 (0.18)
Nom.Exchange Rate Volatility	2.17 (0.49)	2.25 (0.49)	2.23 (0.48)	2.24 (0.48)	2.15 (0.47)
Sum of Tariffs	0.64 (0.19)	0.63 (0.18)	0.49 (0.14)	0.50 (0.14)	0.49 (0.14)
Common Lang.	-1.81 (0.52)	-1.94 (0.52)	-1.94 (0.53)	-1.94 (0.53)	-2.06 (0.53)
CFA					-1.05 (1.87)
		Treatment Equation on Hard Pegs and Currency Unions			
		Currency Union	Currency Union	Currency Union	CU excluding CFA
Synchronization of Business Cycles		1.60 (0.25)	1.42 (0.28)	1.37 (0.28)	1.58 (0.30)
Log Trade		0.46 (0.08)			
Log Real GDP			-0.09 (0.09)		0.03 (0.10)
Log GDP/capita			1.26 (0.19)	1.20 (0.19)	1.90 (0.18)
Log Distance			-0.38 (0.08)	-0.39 (0.08)	-0.25 (0.07)
Border			-0.08 (0.27)	-0.13 (0.26)	0.003 (0.25)
Common Lang.			-0.11 (0.27)	-0.09 (0.26)	-0.39 (0.28)
Com. Colonizer			0.13 (0.31)	1.21 (0.31)	
Landlocked			-0.32 (0.16)	-0.26 (0.15)	-0.22 (0.160)
Rho		0.68 (0.08)	0.77 (0.05)	0.77 (0.05)	0.82 (0.04)
Sigma		0.06 (0.001)	0.06 (0.001)	0.06 (0.001)	0.06 (0.001)
Wald χ^2/p-value	0.79 (R^2)	5121/0.00	5566/0.00	5565/0.00	5580/0.00
# Observations	1652	1625	1650	1650	1652

Note: In parentheses are robust standard errors. Country fixed effects are included in all regressions but not reported to save space. "Synchronization of business cycles" is measured by the correlation of the two countries' HP(10)-filtered log GDP series over 1980-2000. In the last column, "currency union" indicator excludes CFA, which is listed separately.

Table 14: Synchronization of Business Cycles Measured by Correlation in log GDP after a HP(100) Filter
(System Estimation by Maximum Likelihood)

Dependent variable: Band of Deviations from Law of One Price

	Main Equation on Market Integration			
Currency Union	-10.99 (1.27)	-10.49 (0.97)	-10.53 (0.97)	-10.06 (0.94)
Log Distance	14.64 (2.98)	11.36 (3.14)	11.34 (3.13)	11.48 (2.95)
[Log Distance]^2	-0.72 (0.18)	-0.53 (0.19)	-0.53 (0.19)	-0.54 (0.18)
Nom.Exchange Rate Volatility	2.31 (0.48)	2.30 (0.48)	2.31 (0.48)	2.23 (0.48)
Sum of Tariffs	0.62 (0.17)	0.50 (0.14)	0.51 (0.14)	0.52 (0.15)
Common Lang.	-1.90 (0.52)	-1.91 (0.53)	-1.92 (0.53)	-2.07 (0.53)
CFA				-1.03 (1.85)

	Treatment Equation on Hard Pegs and Currency Unions			
	Currency Union	Currency Union	Currency Union	CU excluding CFA
Synchronization of Business Cycles	1.58 (0.23)	1.39 (0.24)	1.36 (0.24)	1.69 (0.26)
Log Trade	0.47 (0.08)			
Log Real GDP		-0.10 (0.09)		0.04 (0.10)
Log GDP/capita		1.32 (0.21)	1.25 (0.20)	2.07 (0.20)
Log Distance		-0.35 (0.08)	-0.36 (0.08)	-0.20 (0.07)
Border		-0.11 (0.26)	-0.16 (0.26)	-0.04 (0.24)
Common Lang.		-0.10 (0.28)	-0.08 (0.28)	-0.46 (0.32)
Com. Colonizer		1.21 (0.32)	1.29 (0.32)	
Landlocked		-0.35 (0.16)	-0.29 (0.14)	-0.22 (0.18)
Rho	0.72 (0.06)	0.78 (0.04)	0.79 (0.04)	0.85 (0.03)
Sigma	0.06 (0.001)	0.06 (0.001)	0.06 (0.001)	0.06 (0.001)
Wald χ^2/p-value	5351/0.00	5556/0.00	5565/0.00	5592/0.00
# Observations	1625	1650	1650	1652

Note: In parentheses are robust standard errors. Country fixed effects are included in all regressions but not reported to save space. "Synchronization of business cycles" is measured by the correlation of the two countries' HP(100)-filtered log GDP series over 1980-2000. In the last column, "currency union" indicator excludes CFA, which is listed separately.

Table 15: Synchronization of Business Cycles Measured by
Correlation in log GDP after a Band-Pass (2, 8) Filter
(System Estimation by Maximum Likelihood)

Dependent variable: Band of Deviations from Law of One Price

	Main Equation on Market Integration			
Currency Union	-12.15 (1.62)	-11.42 (1.06)	-11.41 (1.05)	-11.51 (1.07)
Log Distance	14.42 (3.19)	10.37 (3.20)	10.39 (3.20)	10.75 (3.02)
[Log Distance]^2	-0.71 (0.19)	-0.48 (0.19)	-0.48 (0.20)	-0.50 (0.18)
Nom.Exchange Rate Volatility	2.30 (0.49)	2.21 (0.47)	2.20 (0.47)	2.14 (0.47)
Sum of Tariffs	0.65 (0.18)	0.47 (0.13)	0.47 (0.13)	0.44 (0.13)
Common Lang.	-1.86 (0.52)	-1.89 (0.53)	-1.88 (0.54)	-2.01 (0.53)
CFA				-1.29 (1.82)

	Treatment Equation on Hard Pegs and Currency Unions			
	Currency Union	Currency Union	Currency Union	CU excluding CFA
Synchronization of Business Cycles	0.16 (0.17)	-0.02 (0.18)	-0.02 (0.18)	-0.06 (0.20)
Log Trade	0.60 (0.08)			
Log Real GDP		0.02 (0.08)		0.14 (0.10)
Log GDP/capita		1.25 (0.18)	1.26 (0.18)	1.73 (0.16)
Log Distance		-0.50 (0.07)	-0.50 (0.08)	-0.42 (0.07)
Border		-0.21 (0.25)	-0.20 (0.25)	-0.10 (0.24)
Common Lang.		0.03 (0.21)	0.03 (0.21)	-0.30 (0.23)
Com. Colonizer		1.11 (0.27)	1.09 (0.27)	
Landlocked		-0.46 (0.15)	-0.48 (0.15)	-0.39 (0.16)
Rho	0.74 (0.08)	0.78 (0.05)	0.78 (0.05)	0.83 (0.04)
Sigma	0.06 (0.001)	0.06 (0.001)	0.06 (0.001)	0.06 (0.001)
Wald χ^2/p-value	5179/0.00	5547/0.00	5553/0.00	5547/0.00
# Observations	1625	1650	1650	1652

Note: In parentheses are robust standard errors. Country fixed effects are included in all regressions but not reported to save space. "Synchronization of business cycles" is measured by the correlation of the two countries' Band-Pass (2,8)-filtered log GDP series over 1980-2000. In the last column, "currency union" indicator excludes CFA, which is listed separately.

Appendix Table 1: Prices Studied

1. Apples (1 kg) (supermarket)
2. Aspirin (100 tablets) (supermarket)
3. Bacon (1 kg) (supermarket)
4. Bananas (1 kg) (supermarket)
5. Batteries (two, size D/LR20) (supermarket)
6. Beef: filet mignon (1 kg) (supermarket)
7. Beef: ground or minced (1 kg) (supermarket)
8. Beef: roast (1 kg) (supermarket)
9. Beef: steak, entrecote (1 kg) (supermarket)
10. Beef: stewing, shoulder (1 kg) (supermarket)
11. Beer, local brand (1 l) (supermarket)
12. Beer, top quality (330 ml) (supermarket)
13. Butter, 500 g (supermarket)
14. Carrots (1 kg) (supermarket)
15. Cheese, imported (500 g) (supermarket)
16. Chicken: fresh (1 kg) (supermarket)
17. Chicken: frozen (1 kg) (supermarket)
18. Cigarette, local brand (pack of 20) (supermarket)
19. Cigarettes, Marlboro (pack of 20) (supermarket)
20. Coca-Cola (1 l) (supermarket)
21. Cocoa (250 g) (supermarket)
22. Cognac, French VSOP (700 ml) (supermarket)
23. Cornflakes (375 g) (supermarket)
24. Dishwashing liquid (750 ml) (supermarket)
25. Drinking chocolate (500 g) (supermarket)
26. Eggs (12) (supermarket)
27. Facial tissues (box of 100) (supermarket)
28. Flour, white (1 kg) (supermarket)
29. Fresh fish (1 kg) (supermarket)
30. Frozen fish fingers (1 kg) (supermarket)
31. Gin, Gilbey's or equivalent (700 ml) (supermarket)
32. Ground coffee (500 g) (supermarket)
33. Ham: whole (1 kg) (supermarket)
34. Hand lotion (125 ml) (supermarket)
35. Insect-killer spray (330 g) (supermarket)
36. Instant coffee (125 g) (supermarket)
37. Lamb: chops (1 kg) (supermarket)
38. Lamb: leg (1 kg) (supermarket)
39. Lamb: Stewing (1 kg) (supermarket)
40. Laundry detergent (3 l) (supermarket)
41. Lemons (1 kg) (supermarket)
42. Lettuce (one) (supermarket)
43. Light bulbs (two, 60 watts) (supermarket)
44. Lipstick (deluxe type) (supermarket)
45. Liqueur, Cointreau (700 ml) (supermarket)
46. Milk, pasteurised (1 l) (supermarket)
47. Mineral water (1 l) (supermarket)
48. Olive oil (1 l) (supermarket)
49. Onions (1 kg) (supermarket)
50. Orange juice (1 l) (supermarket)
51. Oranges (1 kg) (supermarket)
52. Peaches, canned (500 g) (supermarket)
53. Peanut or corn oil (1 l) (supermarket)
54. Peas, canned (250 g) (supermarket)
55. Pork: chops (1 kg) (supermarket)
56. Pork: loin (1 kg) (supermarket)
57. Potatoes (2 kg) (supermarket)
58. Razor blades (five pieces) (supermarket)
59. Scotch whisky, 6 years old (700 ml) (supermarket)
60. Sliced pineapples, canned (500 g) (supermarket)
61. Soap (100 g) (supermarket)
62. Spaghetti (1 kg) (supermarket)
63. Sugar, white (1 kg) (supermarket)
64. Tea bags (25 bags) (supermarket)
65. Toilet tissue (two rolls) (supermarket)
66. Tomatoes (1 kg) (supermarket)
67. Tomatoes, canned (250 g) (supermarket)
68. Tonic water (200 ml) (supermarket)
69. Toothpaste with fluoride (120 g) (supermarket)
70. Vermouth, Martini & Rossi (1 l) (supermarket)
71. White bread, 1 kg (supermarket)
72. White rice, 1 kg (supermarket)
73. Wine, common table (1 l) (supermarket)
74. Wine, fine quality (700 ml) (supermarket)
75. Wine, superior quality (700 ml) (supermarket)
76. Yoghurt, natural (150 g) (supermarket)
77. Boy's dress trousers (chain store)
78. Boy's jacket, smart (chain store)
79. Business shirt, white (chain store)
80. Business suit, two piece, medium weight (chain store)
81. Child's jeans (chain store)
82. Child's shoes, dress wear (chain store)
83. Child's shoes, sportswear (chain store)
84. Cost of six tennis balls e.g., Dunlop, Wilson (average)
85. Dress, ready to wear, daytime (chain store)
86. Fast food snack: hamburger, fries and drink (average)
87. Frying pan (Teflon or good equivalent) (supermarket)
88. International foreign daily newspaper (average)
89. Kodak colour film (36 exposures) (average)
90. Men’s raincoat, Burberry type (chain store)
91. Men's shoes, business wear (chain store)
92. Socks, wool mixture (chain store)
93. Tights, panty hose (chain store)
94. Women's cardigan sweater (chain store)
95. Women's shoes, town (chain store)

Appendix Table 2: Cities Included

1	Abidjan	Cote d'Ivoire
2	Abu Dhabi	UAE
3	Amman	Jordan
4	Amsterdam	Netherlands
5	Asuncion	Paraguay
6	Athens	Greece
7	Atlanta	United States
8	Auckland	New Zealand
9	Bahrain	Bahrain
10	Bangkok	Thailand
11	Beijing	China,P.R.
12	Berlin	Germany
13	Bogota	Colombia
14	Boston	United States
15	Brussels	Belgium
16	Budapest	Hungary
17	Buenos Aires	Argentina
18	Cairo	Egypt
19	Caracas	Venezuela
20	Casablanca	Morocco
21	Chicago	United States
22	Cleveland	United States
23	Colombo	Sri Lanka
24	Copenhagen	Denmark
25	Dakar	Senegal
26	Detroit	United States
27	Douala	Cameroon
28	Dublin	Ireland
29	Guatemala City	Guatemala
30	Helsinki	Finland
31	Hong Kong	Hong Kong
32	Honolulu	United States
33	Houston	United States
34	Istanbul	Turkey
35	Jakarta	Indonesia
36	Johannesburg	South Africa
37	Karachi	Pakistan
38	Kuala Lumpur	Malaysia
39	Kuwait	Kuwait
40	Lagos	Nigeria
41	Libreville	Gabon
42	Lima	Peru
43	Lisbon	Portugal
44	London	United Kingdom
45	Los Angeles	United States
46	Luxembourg	Luxembourg
47	Madrid	Spain
48	Manila	Philippines
49	Mexico City	Mexico
50	Miami	United States
51	Montevideo	Uruguay
52	Moscow	Russia
53	Mumbai	India
54	Nairobi	Kenya
55	New York	United States
56	Oslo	Norway
57	Panama City	Panama
58	Paris	France
59	Pittsburgh	United States
60	Port Moresby	Papua New Guinea
61	Prague	Czech Republic
62	Quito	Ecuador
63	Riyadh	Saudi Arabia
64	Rome	Italy
65	San Francisco	United States
66	San Jose	Costa Rica
67	Santiago	Chile
68	Sao Paulo	Brazil
69	Seattle	United States
70	Seoul	South Korea
71	Singapore	Singapore
72	Stockholm	Sweden
73	Sydney	Australia
74	Taipei	Taiwan
75	Tehran	Iran
76	Tel Aviv	Israel
77	Tokyo	Japan
78	Toronto	Canada
79	Tunis	Tunisia
80	Vienna	Austria
81	Warsaw	Poland
82	Washington DC	United States
83	Zurich	Switzerland

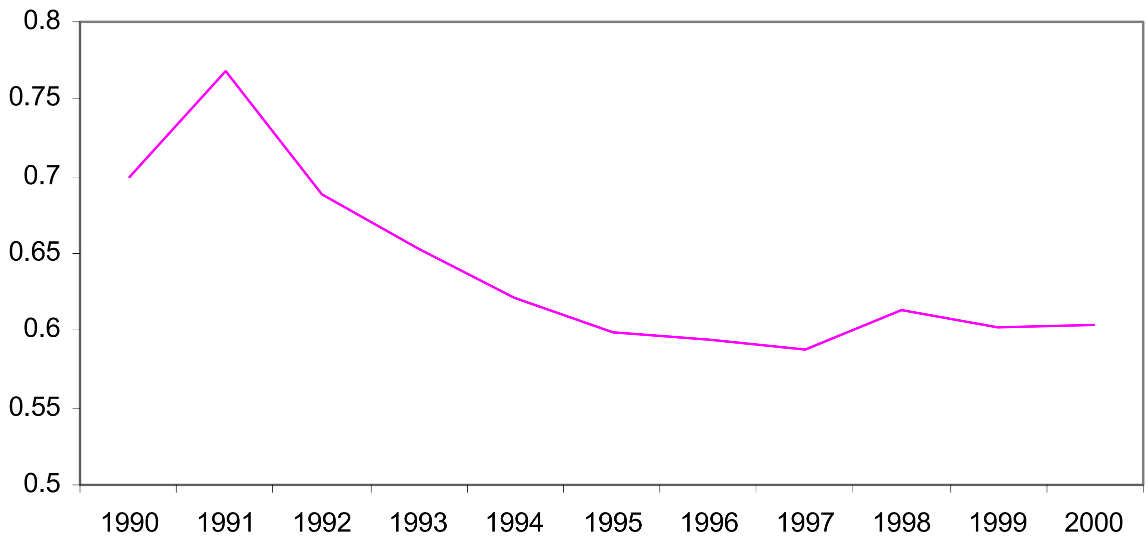
Figure 1: Schematic Summary of the O'Connell-Wei (2002) Model

Percentage
Price Differential

----------------[----------------(----------|----------)---------------]----------------

c1 c2 0 c3 c4

Figure 2: Dispersion averaged over all city-pairs



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